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CONSUMPTION FORECASTS FOR SELECTED AGRICULTURAL
PRODUCTS IN CANADA

by

Natalie Smillie

A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled CONSUMPTION FORECASTS FOR SELECTED AGRICULTURAL PRODUCTS IN CANADA submitted by Natalie Smillie in partial fulfilment of the requirements for the degree of Master of Business Administration.

ABSTRACT

This thesis uses single-equation systems to forecast the consumption requirements for beef, pork, and wheat in Canada. The statistical aspects of the equations are discussed in detail followed by forecasts of the consumption requirements for these products in 1980. Because domestic consumption requirements are not the sole determinants of the market outlook for these products, export estimates from the Royal Commission on Canada's Economic Prospects, (1957) are used to derive a total Canadian market requirement for beef, pork, and wheat in 1980. The study is concluded by a discussion of some of the implications of the foregoing forecasts to Canadian and Albertan farmers.

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CHAPTER I

INTRODUCTION

There have been many significant changes in Canadian agriculture in recent years. According to the 1966 Census of Canada the area in farms has increased by less than 1% since 1941; however, the number of farms has declined by 41% during the same period. Another notable development is the rapidity with which farming has become mechanized. For example, in 1941 there were only 159,752 tractors and 19,013 combines on Canadian farms. By 1966 the number of tractors and combines on Canadian farms has increased to 598,483 and 170,182, or 275% and 795%, respectively. As a result of these changes, farming in Canada has become more commercial.

Although the number of farms has decreased considerably in the past 25 years, there is still a large number of producing units in agriculture which act independently and without any knowledge of the plans of others in determining the amount and type of products that they will produce. At the same time, heavy investment in machinery and equipment tends to hamper the speed with which a farm may change the type of product it produces. Thus, agricultural production is frequently slow to respond to market requirements. This, combined with

the low elasticity of demand for agricultural products, most commonly results in widely fluctuating farm prices and income. Although long-range commodity market forecasts cannot solve these problems, they could serve to encourage more agricultural production planning. Of course it must be recognized that agricultural production is subject to the hazards of the weather and of plant and animal diseases so that inevitably variations in the supply of particular commodities will occur. However, agricultural production planning could reduce fluctuations in farm prices and income considerably.

The time that may be allotted to a development of a thesis does not allow an examination of all the agricultural products currently produced in Canada. Accordingly, only the three major income-producing agricultural products in Alberta in recent years have been selected. These are beef, pork, and wheat (Farm Cash Receipts, Fourth Quarter and Annual Totals, 1961-66 issues).

Thus, this study proposes to use single-equation systems to forecast the consumption of beef, pork, and wheat in Canada in 1980. Since Canadian agricultural production is not used solely to satisfy domestic consumption requirements, it is necessary to examine the export prospects for the products which have been selected. There are many sources from which an estimate of

Canadian future export trade in beef, pork, and wheat may be obtained. The particular source which has been chosen for this study is the Royal Commission on Canada's Economic Prospects (1957).

When the anticipated domestic and external requirements for Canadian beef, pork, and wheat in 1980 are combined, it is then possible to indicate whether further expansion of production in these products will be warranted in future. The forecasts for 1980 are bound to be provisional because of the limitations of the methods and the assumptions that have been used. Nevertheless, it is felt that efforts to appraise the future are worthwhile. Thus, the study will be concluded with a discussion of some of the implications of the forecasts to Canadian and Albertan farmers.

CHAPTER II

THE METHOD FOR ESTIMATING THE HUMAN CONSUMPTION OF BEEF, PORK, AND WHEAT IN CANADA

2.1 Some General Remarks on Regression Analysis

In this section a few remarks shall be made on those aspects of linear regression analysis which are relevant to the material in the remainder of this chapter. The principal problem of linear regression is to examine the dependence of a variable, known as the dependent variable on one or more other variables, known as the independent variables. If there is a single independent variable, then the regression is known as simple regression. If there are several independent variables, then the regression is known as multiple regression. Simple regression will be considered first, and then multiple regression will be mentioned briefly.

Therefore, if it is assumed that there is a single independent variable X and a dependent variable Y , and that these variables are related by the linear relation

$$Y = \beta_0 + \beta_1 X + u ,$$

where β_0 is the constant term, β_1 is the unknown true regression coefficient and u is a random term which is necessary because of the departure of Y from the exact

linear dependence on X . The observed value of Y may differ from the estimated value of Y for one of the following reasons:

- (1) The variation in Y could be fully explained if all the factors affecting Y were known and all the necessary data were available. However, this is seldom possible. In the case of simple regression only one factor affecting Y is identified.
- (2) Most economic statistics contain errors of measurement. Such errors may arise because totals are estimated on a sample basis or, even if a complete enumeration is attempted, some errors invariably occur.

Thus, the net effect of the excluded variables plus errors of measurement and other random variations are represented by u . It is assumed that u is a random variable with a mean of zero, a constant variance of σ^2 and a zero covariance, and is also statistically independent of X . If the assumption regarding the statistical independence of X and u is not satisfied, the estimates may be biased. It is required on the basis of observations on the variables X and Y to obtain estimates of the parameters β_0 , β_1 , and the variance σ^2 , all of which are unknown.

Now, if it is assumed that there are n pairs of observations (X_i, Y_i) , $i=1,2,\dots,n$, on the variables X and Y , and that these observations satisfy the relations

$$Y_i = b_0 + b_1 X_i + e_i ,$$

where b_0 and b_1 are estimates of β_0 and β_1 , respectively, and e_i is the i th estimate of the random term u , and is known as the i th residual. For given values of b_0 and b_1 , the quantity

$$Y'_i = b_0 + b_1 X_i$$

is the estimate provided by the regression line of the i th value of the dependent variable Y_i . The i th residual e_i measures the departure of the observed value of the dependent variable from its estimated value. A measure of the total departure of the estimated values from the observed values is given by the sum of squares of the residuals

$$\sum_{i=1}^n e_i^2 = \sum_{i=1}^n (Y_i - b_0 - b_1 X_i)^2 .$$

The estimates, b_0 and b_1 , of β_0 and β_1 , respectively, in the least-squares sense are those which minimize the total sum of squares of the residuals, and may be obtained from the solution of two simultaneous

linear algebraic equations, the so-called normal equations. Once these estimates are known, it is possible to find the total sum of squares of the residuals. This quantity, divided by $n-2$, is an unbiased estimate of the variance σ^2 of the random term u . The positive square root of this estimate is known as the standard error of estimate.

Of particular value is a test of the significance of the regression coefficient b_1 provided that u is normally distributed. Such a test is provided by the t -statistic which is the ratio of b_1 to its standard error which may be obtained as a by-product of the solution of the normal equations. This statistic is distributed in a Student's t -distribution with $n-2$ degrees of freedom.

When the estimates of the constant term and the regression coefficient have been obtained, it is possible to partition the total sum of squares of the deviations of the dependent variable from its mean into a part due to regression and a residual part due to error. This latter part is merely the total sum of squares of the residuals. Furthermore, it is convenient to display this information in an analysis-of-variance table giving the sums of squares and degrees of freedom due to regression, error and total, the mean square for regression and error, and finally the F -Ratio. This last quantity provides one measure of the goodness of fit of the regression line to

the data. Finally, it may be noted that the positive square root of the proportion of the total variation which is due to regression is merely the simple correlation coefficient.

Of particular interest and importance in econometric studies are tests for serial correlation in the residuals. One well known test is the Durbin-Watson statistic given by

$$d = \frac{\sum_{i=2}^n (e_i - e_{i-1})^2}{\sum_{i=1}^n e_i^2} .$$

The derivation of this statistic is given in Durbin and Watson (1950, 1951). Tables in the second of these papers give upper and lower bounds for this statistic for various sample sizes and significance levels and for up to five independent variables.

Another related test for serial correlation is given by von Neumann's ratio

$$\eta = \frac{\delta^2}{s^2}$$

where

$$\delta^2 = \frac{\sum_{i=1}^{n-1} (e_{i+1} - e_i)^2}{n - 1}$$

and

$$s^2 = \frac{\sum e_i^2}{n}$$

which has been tabulated for various values of n in Ezekiel and Fox (1959).

Finally, a non-parametric test of the residuals may be given by a test of the number of runs in the signs of the residuals. A run in this context may be defined as an unbroken subsequence of positive (negative) signs either at the beginning of the sequence or preceded by a negative (positive) sign and terminated either by the end of the sequence or by a negative (positive) sign. A tendency for relatively long runs of positive and negative signs would indicate serial correlation in the residuals. Tables of critical values for runs of various lengths have been given in Swed and Eisenhart (1943) and also in Hoel (1966).

Although there are many other methods for testing for non-randomness in the residuals, the above three tests should provide an adequate indication of whether the residuals appear to be random or not.

Where the dependent variable is influenced by several independent variables and where the interest is primarily in the estimation of values of the dependent variable from knowledge of several independent variables,

multiple linear regression will provide the combined effect of several variables on the one of primary concern. The linear relationship between the dependent variable Y and the independent variables X_k where $k=1,2,\dots,k$, may be stated as follows:

$$Y = \beta_0 + \beta_1 X_1 + \dots + \beta_k X_k + u$$

where $\beta_0, \beta_1, \dots, \beta_k$ are the unknown true regression coefficients and u is a random term which denotes the departure of the estimated value of Y from the observed value of Y .

The same basic assumptions apply to both the simple and multiple regression models. However, an additional important assumption must be made. This added assumption is that $X_i, i=1,2,\dots,k$, must be linearly independent.

For the multiple variable case the linear relation for the i th observation may be written as follows:

$$Y_i = b_0 + b_1 X_{i1} + \dots + b_k X_{ik} + e_i$$

The sample statistics that may be employed in describing the relationship between three (or more) variables are an extension of those used in the two-variable case. That is, the problem is

- (1) To compute the b 's which are estimates of the true regression coefficients, the β 's.

- (2) To compute the estimate of the variance of the disturbance term u .
- (3) To compute the proportion of the total variation due to regression.
- (4) To prepare an analysis-of-variance table.
- (5) To test for randomness in the residual term.

The formulae for computing the above estimates in a multiple regression problem become cumbersome and may be treated more efficiently with the use of matrix algebra. A full treatment of the general regression model may be obtained from many sources, for example, Johnston (1963).

The independent variables may be introduced into a multiple regression either in some order which is determined before the calculations are done or in an order determined by the contribution of each independent variable to the reduction in the error sum of squares. This second method, known as stepwise regression, introduces first into the regression that independent variable which is most highly correlated with the dependent variable. The independent variable introduced second is that one with the highest first-order partial correlation coefficient with the dependent variable when the effect of that independent variable already in the regression has been removed. A similar successive examination of higher-order partial correlation coefficients will determine the order of intro-

duction of the remaining independent variables.

An inspection of the t -values of the regression coefficients and of the amount of variation accounted for by each independent variable will determine if any of the independent variables may be omitted from the regression. If one or more may be deleted, the stepwise procedure is repeated with the reduced set of independent variables. An inspection of these results may result in further independent variables being omitted. Eventually a regression function will be obtained which contains only those independent variables which are considered to be significantly related to the dependent variable.

Linear regression equations are frequently used for prediction. When one wishes to say something about a future value of Y or when it is possible to observe an X value or several X values and impossible or impractical to observe the corresponding Y value, one may give as a prediction the regression estimate of the value of Y . The accuracy of a predicted value of Y may be indicated by the standard error of estimate, the coefficient of determination or the coefficient of multiple correlation, and tests of randomness on the disturbance term. Caution must be exercised when estimating a value for Y using an X value outside the observed range of X . One must assume that the relationship will continue to be linear.

Of course regression analysis is not restricted to linear models. However, the selection of a form of regression equation which best expresses a nonlinear relation is a complex problem. A graphical inspection of the data may indicate the inappropriateness of using a linear relationship. Or, the subject matter may provide some theory relative to the form of curve which should be used. Before a curvilinear function is chosen, it is well to consider whether confidence limits and tests of significance will be valid. To avoid these problems it is frequently possible to transform the initial data so that the relationship between the transformed data appears linear. For example, a function such as

$$Y = AB^XV$$

may be made linear by the following logarithmic transformation:

$$\log Y = \log A + (\log B)X + \log V .$$

The linear regression model can then be used to obtain regression estimates of Y .

Finally, it should be noted that the forecasts based on single-equation regression models may be somewhat biased since no account is taken of the system of economic relations in which the single equation is embedded. A more

sophisticated method for deriving forecasting models is to use simultaneous equation systems. A comparison between the two types of forecasting models, however, is beyond the scope of this study.

The regression calculations for this thesis have been performed using a set of statistical programs called *STATPACK1* written in APL, an operational version of Iverson's language, which has been implemented on several models of the IBM 360 and used through either IBM 1050 or 2741 terminals. The particular system used was the IBM 360/67 in the Department of Computing Science at the University of Alberta. An account of *STATPACK1* may be found in Smillie (1968).

2.2 The Variables

Since the purpose of this chapter is to derive estimating equations for the human consumption of beef, wheat, and pork in Canada, the choice of these three variables as the dependent variables in the regression equations is obvious. It is assumed that beef and pork are homogeneous products, i.e., that each pound of beef is composed of fixed proportions of the various beef cuts such as sirloin steak, round steak, rib roast, blade roast, stewing beef, hamburger, etc. Similarly, each pound of pork is assumed to be composed of fixed proportions of bacon, ham, rib

chops, roast, sausages, etc. Since data on the consumption of wheat in forms other than flour are not available, only the wheat equivalent of wheat flour consumption will be considered.

For the independent variables it is necessary to choose variables which are logically related to the dependent variables. Further, it is necessary to specify the direction of change that may be expected in the dependent variables due to a change in each of the independent variables. Then, if these independent variables explain a significant amount of the variation in the dependent variables, the data meet the various tests for significance discussed in the previous section, and the direction of change indicated by the regression coefficients is logical, it may be concluded that good estimating equations for the dependent variables have been obtained.

The first independent variable which has been selected is Canada's population. That population is a logical explanatory variable in a study of beef, wheat, and pork consumption is clearly apparent. That changes in the consumption of beef, wheat, and pork should be in the same direction as changes in population is equally clear.

Food budget studies indicate that as the level of income rises in a household, per capita consumption in

that household of various food categories changes (Caves and Holton, 1959). The consumption of bread grains and potatoes declines. More fruit and vegetables are bought and, in particular, consumers use their higher incomes to buy more meat, poultry, and eggs. Thus, if the general level of income is rising, it may be expected that wheat consumption will decline since in recent years wheat flour accounted for more than 95% of the total flour consumption in Canada. Also, it is reasonable to infer that the consumption of beef and pork will be an increasing function of income since beef and pork constitute the major portion of total meat and poultry consumption (Appendix A, Table A-1). When aggregate income data are used as an independent variable, the relationships obtained may be somewhat distorted because aggregate income reflects changes in the number of income recipients as well as changes in the general level of income. This problem could be avoided if one could compute the income per household. However, since such data are not available, per capita income is often used instead. Accordingly, two regression models will be used, one with per capita income and the other with aggregate income as independent variables.

It is reasonable to assume that the consumer is guided primarily by the net income he receives. Therefore,

the particular income data which have been chosen as independent variables are those for the annual deflated personal disposable income and annual per capita personal disposable income. Personal disposable income may be defined as that income received by persons, whether or not these receipts represent earnings from production, less personal taxes. It includes transfer payments from government such as family allowances, unemployment insurance benefits and war service gratuities, in addition to wages and salaries, net income of unincorporated business, interest and dividends, and net rental income of persons. Or, alternatively, personal disposable income may be defined as personal expenditure on consumer goods and services plus personal savings. The deflator that has been chosen will be discussed in the following section.

When specific types of meat are studied, the prices of the various meats must be considered as important determinants of the type of meat that will be purchased. Since all meat prices do not change in the same direction or magnitude, it should be expected that some substitution between meats will take place as their prices change. Therefore, the prices of beef, pork, veal, lamb, mutton, offal, canned meats, poultry, and fish could be considered as relevant variables in a study of beef and

pork consumption. One way in which a measure of the importance of meat, poultry, and fish prices on beef consumption can be obtained is to compute the ratio of the index of beef prices to the weighted index of meat, poultry, and fish prices. This ratio may then be used as an independent variable. Unfortunately, the fish consumption figure for 1965 is not available. Since fish accounted for only 6.8% to 8.2% of the total meat, poultry, and fish consumption during the period 1949-64, the exclusion of fish from the denominator of the ratio was considered advisable (Canada Year Book, 1952-67 Editions). The simple correlation between the ratio including fish and that excluding fish for the period 1949-64 is .994. Thus, it was concluded that the omission of fish from the analysis would not significantly alter the results and would permit the use of an additional observation. Therefore, the ratio of the index of beef prices to the weighted index of meat and poultry prices will be used as an independent variable in the regression equation for beef consumption. Similarly, the ratio of the index of pork prices to the weighted index of meat and poultry prices will be used as an independent variable in the regression equation for pork consumption since the simple correlation between the ratio including fish and that excluding fish for the period 1949-64 was also .994. The price ratio

which will be used in the regression equation for wheat consumption is the ratio of the index of flour prices to the index of potato prices. If the assumptions are correct, it should be expected that as the ratios increase beef, pork, and wheat consumption will decrease.

Finally, the form of regression model that has been selected is the multiple linear regression model. There is no evidence that a curvilinear model would be more appropriate.

2.3 The Data

When time-series data are used in regression analysis, it is desirable that the data for years in which abnormal variations occurred be excluded. Consequently, the data have been chosen beginning with 1949 in order to exclude the abnormal variations due to such factors as rationing, wage controls, and price controls which were in effect during World War II and the early post-war period. The most recent year for which data were available for beef and pork consumption was 1965. The year 1964 was the most recent year for which data for wheat consumption were available. Thus, the regression equations for beef and pork consumption will be obtained from data for the period 1949-65, inclusive. The regression equation for wheat consumption will be derived from data covering the

period 1949-64, inclusive.

The data for beef, wheat, and pork consumption are shown in Table 2-1.

The beef and pork consumption data are on the basis of cold dressed carcass weight. Prior to January 1, 1951 fancy meats were included in the inventory figures which were used to derive the consumption figures. However, the data for the period 1949-65 may be assumed to be comparable since inventory fluctuations during the period 1949-50 were relatively small.

The wheat consumption data were derived by taking annual per capita wheat flour consumption times the annual population estimates to obtain the total annual consumption of wheat flour. This annual consumption of flour was then converted to annual consumption of wheat by using a conversion factor of 2.3 bushels of wheat per one hundred pounds of flour (Appendix A, Table A-2). The conversion factor was obtained from the Handbook of Agricultural Statistics Part 1 - Field Crops 1908-63.

Unfortunately, rye flour was included with the wheat flour in the per capita wheat flour consumption estimates.

Although the data in Appendix A, Table A-3 are not comparable to the data used in this study, they do indicate that rye flour constitutes a negligible proportion of wheat flour consumption. Also, data for the consumption

Table 2-1 The Dependent Variables.

Year	Y ₁ Beef Consumption (Pounds)	Y ₂ Pork Consumption (Pounds)	Y ₃ Wheat Consumption (Bushels)
		- Millions -	
1949	758.1	734.7	46.1
1950	696.0	753.4	48.8
1951	691.0	820.6	49.0
1952	786.1	809.5	50.6
1953	965.8	722.6	49.5
1954	1,072.7	693.9	51.9
1955	1,085.4	772.2	52.1
1956	1,148.0	790.5	53.7
1957	1,196.6	738.2	53.0
1958	1,161.7	843.0	56.2
1959	1,146.1	990.7	54.7
1960	1,250.0	939.9	55.7
1961	1,271.3	910.3	56.1
1962	1,287.6	925.4	57.1
1963	1,395.2	958.8	60.5
1964	1,512.1	1,001.5	56.1
1965	1,543.2	964.7	n.a.

Sources: Handbook of Agricultural Statistics Part VI
Livestock and Animal Products 1871-1965,
 Catalogue No. 21-508, Occasional, Dominion
 Bureau of Statistics.

Appendix A, Table A-2.

of wheat in other forms than flour are not available. Thus, the wheat consumption estimates may be somewhat understated or overstated. The error, however, does not appear to be significant.

The data for the independent variables are contained in Tables 2-2 and 2-3.

The population estimates for 1951, 1956, and 1961 were obtained from census enumerations. For the intervening years the Dominion Bureau of Statistics derived the estimates by taking the preceding census estimate, adding births and immigration, and subtracting deaths and emigration for each succeeding year. When the figures became available for a new census, the estimates for the intervening years were adjusted to the newly recorded population figures. Thus, the population estimates for 1949-61, inclusive are adjusted figures. Whereas the population estimates for 1962-65, inclusive are still subject to adjustment as a result of the 1966 Census.

The personal disposable income in current dollars was computed by adding together personal expenditures on consumer goods and services and personal net savings. In order to eliminate the effects of price changes from the data and to recognize changes in expenditure patterns a personal expenditure index was computed which was sub-

Table 2-2 The Independent Variables.

Year	X ₁ Population (Millions)	X ₂ Personal Disposable Income (Billions of Dollars) (1955 = 100)	X ₃ Per Capita Personal Disposable Income (Dollars) (1955 = 100)
1949	13.4	14.0	1044
1950	13.7	14.6	1061
1951	14.0	15.4	1099
1952	14.5	16.3	1126
1953	14.8	17.1	1155
1954	15.3	17.0	1111
1955	15.7	18.3	1168
1956	16.1	19.9	1237
1957	16.6	20.2	1216
1958	17.1	21.2	1239
1959	17.5	21.9	1250
1960	17.9	22.7	1267
1961	18.2	23.3	1278
1962	18.6	25.0	1346
1963	18.9	26.2	1386
1964	19.2	27.3	1417
1965	19.6	29.5	1507

Sources: Canada Year Book, 1961 and 1966 Editions,
Dominion Bureau of Statistics.

Appendix A, Tables A-4 and A-5.

Table 2-3 The Independent Variables (Concluded).

Year	X_4	X_5	X_6
	<u>Beef Price Index</u> Meat and Poultry Price Index	<u>Pork Price Index</u> Meat and Poultry Price Index	<u>Flour Price Index</u> Potato Price Index
1949	1.000	1.000	1.000
1950	1.118	0.927	1.099
1951	1.178	0.875	1.070
1952	1.188	0.850	0.538
1953	1.023	0.982	0.974
1954	1.003	1.070	1.024
1955	1.057	0.976	0.791
1956	1.063	0.979	0.763
1957	1.044	1.091	0.938
1958	1.117	0.983	0.871
1959	1.206	0.923	0.855
1960	1.169	0.923	0.754
1961	1.156	1.002	0.940
1962	1.195	0.975	1.038
1963	1.169	0.982	0.998
1964	1.164	0.990	0.912
1965	1.149	1.046	n.a.

Source: Appendix A, Tables A-6, A-7, and A-8.

sequently used to deflate the personal disposable income data. The personal expenditure index was computed by dividing the annual constant dollar expenditures on consumer goods and services into the annual current dollar expenditures on consumer goods and services. This personal expenditure index was in 1949 dollars. It was subsequently converted to 1955 dollars and used to deflate the personal disposable income. Tables A-4 and A-5 of Appendix A show the data used to compute the personal disposable income in 1955 dollars. It was necessary to convert the personal disposable income data to 1955 dollars because the estimates which will be used in the forecasts are stated in 1955 dollars. Personal savings were also deflated using the personal expenditure index because a more suitable index for deflating this component of personal disposable income could not be found. The personal expenditure index is considered to be more suitable for this study than the consumer price index because in the annual constant dollar series each item is deflated with a price index that has been selected and constructed so that its commodity content and weighting pattern reflects not only changes in prices but also changes in expenditure patterns.

The data used to compute the ratios are contained in Tables A-6, A-7, and A-8 of Appendix A. A full description

of the method used to compute the indexes of beef, pork, poultry, other meat, flour, and potato prices may be found in The Consumer Price Index for Canada (1949 = 100), (Revision Based on 1957 Expenditures).

2.4 The Regression Equation for Beef Consumption

A regression equation of the type

$$Y_1 = b_0 + b_1X_1 + b_2X_2 + b_4X_4 + e$$

was fitted to the data by the method of least squares, where

Y_1 = beef consumption in millions of pounds,

X_1 = population in millions,

X_2 = personal disposable income in billions
of (1955) dollars,

X_4 = ratio of the index for beef prices to the
index for meat and poultry prices¹.

The variables were introduced into the regression in the stepwise order. The regression equation obtained was

$$Y_1' = 229.83 + 106.21X_1 - 1090.82X_4 + 16.944X_2$$

(4.9251) (-8.9572) (1.7974)

where the figures in brackets below the regression coef-

¹ Another index for meat and poultry prices which might have been used is one excluding beef prices.

ficients indicate the t-values of the coefficients. If one or more independent variables in any regression have sample regression coefficients which are not significantly different from zero at the 5% level as indicated by the t-values, these variables are omitted from the regression one at a time until all of the remaining independent variables have significant regression coefficients.

Upon examination of this regression equation it is noted that the direction of change in beef consumption indicated by the regression coefficients X_1 , X_2 , and X_4 is consistent with the previous assumptions regarding the probable effects of these variables. That is,

- (1) The changes in the consumption of beef are in the same direction as the changes in population.
- (2) The changes in the consumption of beef are in the same direction as the changes in personal disposable income.
- (3) As the ratio of the index of beef prices to the index of meat and poultry prices increases, beef consumption declines.

The percentage of variation in beef consumption accounted for by the three independent variables is as follows:

X_1 accounted for 92.46%

X_4 accounted for 6.26%

X_2 accounted for 0.26%

The total variation accounted for is 98.97%. The standard error of estimate is 29.74 million pounds.

The computed value of the Durbin-Watson statistic was 1.56. The lower and upper bounds for this statistic for a sample of seventeen observations and three independent variables are 0.67 and 1.43, respectively, at the 1% level of significance. If the computed statistic is greater than the upper bound, it may be concluded that there is no serial correlation. Thus, there appears to be no significant serial correlation in the residuals at the 1% level of significance. The Durbin-Watson statistic was also tested at the 5% level of significance. The critical values at the 5% level are 0.90 and 1.71 for the lower and upper bounds, respectively. When the computed statistic lies between the lower and upper bounds, as it does at the 5% level, the test is inconclusive.

The statistic for the von Neumann's ratio test for serial correlation in the residuals was 1.66. The lower and upper critical values for a sample this size are 1.04 and 3.21, respectively, at the 1% level of significance. At the 5% level of significance the lower critical value

is 1.33 and the upper critical value is 2.92. When the computed ratio falls between the two critical values, it can be assumed that no evidence of serial correlation is present. Therefore, this test would indicate that there is no evidence of serial correlation in the residuals at either the 1% or 5% level of significance.

Finally, the lower and upper critical values for the number of runs test are 5 and 14, respectively. The number of runs in the sample was 9. Hence, it may be concluded that the residuals in the sample behave like a random sequence.

It was stated earlier that the predictive value of a regression equation is determined by the amount of variation accounted for, the variance of the estimators, the standard error of estimate, tests for randomness in the residuals, and tests of significance on the regression coefficients. The amount of variation accounted for by the independent variables in the foregoing regression equation is substantial. The standard error of estimate is not large in relation to the magnitude of recent annual beef consumption figures. The tests on the residuals do not indicate any significant serial correlation. However, X_2 accounts for only 0.26% of the variation. The t -value for X_2 indicates that the coefficient of X_2 is not significantly different from

zero. Therefore, it was considered necessary to eliminate X_2 as an independent variable and to compute a new regression equation for beef consumption using only X_1 and X_4 as independent variables.

The elimination of X_2 as an independent variable from a regression equation on beef consumption would appear to contradict the findings of food budget studies. This, however, is not true. The correlation between personal disposable income and population is .99. When some or all of the explanatory variables in a regression equation are not linearly independent of one another, a problem known as multicollinearity is encountered. In such a situation it becomes almost impossible to disentangle their separate influences and obtain a reasonably precise estimate of their relative effects. Thus, the elimination of disposable income as an independent variable indicates only that due to multicollinearity the effect of this variable is not measurable statistically. However, when forecasting is the primary objective, the intercorrelation of two explanatory variables and the subsequent elimination of one of them is not serious provided it may reasonably be expected to continue in the future. It is reasonable to assume that population and aggregate personal disposable income will always be highly correlated.

Before proceeding with the regression equation using

X_1 and X_4 as independent variables, the same type of regression equation as that above was fitted to the data using per capita disposable income in place of aggregate disposable income. The following regression equation was obtained

$$Y_1' = -147.70 + 118.84X_1 - 1085.03X_4 + 0.4155X_3$$

$$(9.4462) \quad (-9.2689) \quad (2.1321)$$

where Y_1 , X_1 , and X_4 are the same as in the previous regression equation and X_3 is per capita disposable income.

The direction of change in beef consumption indicated by the regression coefficients X_1 , X_4 , and X_3 is consistent with the previous assumptions regarding the probable effects of these variables.

The percentages of variation in beef consumption accounted for by X_1 and X_4 are the same as that in the previous regression equation. X_3 accounted for 0.33% of the variation. The total variation accounted for is 99.05%. The standard error of estimate is 28.60 million pounds.

The critical values for the Durbin-Watson statistic are the same as those in the previous regression equation since the sample size and the number of independent variables are the same. The computed value of the

statistic was 1.80. Thus, the test indicates that there is no significant serial correlation at either the 1% or 5% level of significance.

The statistic for the von Neumann ratio test was 1.91. The critical values are the same as those in the previous regression equation and it may be concluded that there is no evidence of serial correlation in the residuals at either the 1% or 5% level of significance.

The lower and upper critical values for the number of runs test are 5 and 14, respectively. The number of runs was 9. Thus, the residuals in the sample appear to behave like a random sequence.

Therefore, when per capita disposable income is used as an independent variable in place of aggregate disposable income, the amount of variation accounted for is slightly greater, the standard error of estimate is somewhat smaller, and the tests on the residuals indicate that there is no evidence of serial correlation. However, the t-value for X_3 indicates that the coefficient of X_3 is not significantly different from zero. The correlation between population and per capita disposable income is .97. Thus, multicollinearity exists in this regression equation as well. Consequently, it was considered necessary to eliminate X_3 as an independent variable in the regression equation.

As a result of the above findings, a regression equation was fitted to the data for beef consumption using only X_1 (population) and X_4 (ratio of the index for beef prices to the index for meat and poultry prices). The following regression equation was obtained:

$$Y_1' = -58.23 + 144.21X_1 - 1083.29X_4.$$

(31.5748) (-8.2664)

The direction of change in beef consumption indicated by the regression coefficients X_1 and X_4 is consistent with the previous assumptions.

The percentages of variation in beef consumption accounted for by each of the independent variables is the same as before. The total variation accounted for is now 98.72%. The standard error of estimate is 32.02 million pounds.

The computed value of the Durbin-Watson statistic, is 1.16. The lower and upper bounds for this statistic for a sample of seventeen observations and two independent variables are 0.77 and 1.25, respectively, at the 1% level of significance. The critical values at the 5% level are 1.02 and 1.54 for the lower and upper bounds, respectively. Thus, the Durbin-Watson test on the residuals is inconclusive at both the 1% and 5% levels of significance.

The statistic for the von Neumann ratio test is 1.23. The critical values are the same as those in the preceding regressions. Therefore, there is no evidence of serial correlation in the residuals at the 1% level of significance but serial correlation appears to be significant at the 5% level.

The number of runs in the sample was 6. The lower and upper critical values are 5 and 14, respectively. Hence, it may be concluded that the residuals in the sample behave like a random sequence.

The t -values for X_1 and X_4 indicate that the coefficients of these variables are significantly different from zero.

However, since the Durbin-Watson statistic was inconclusive at both the 1% and 5% levels of significance and the von Neumann ratio indicated significant serial correlation in the residuals at the 5% level of significance, it was deemed advisable to transform the original data using differences to see if a regression equation based on the transformed data would eliminate the serial correlation in the residuals.

The method used to transform the data was as follows:

- (1) The coefficient of correlation r of a first-order autoregressive scheme for the residuals was computed. The value of r was 0.3811.

- (2) The original variables were transformed as follows:

$$Y_{1i}^* = Y_{1i} - 0.3811Y_{1,i-1},$$

$$X_{1i}^* = X_{1i} - 0.3811X_{1,i-1},$$

$$X_{4i}^* = X_{4i} - 0.3811X_{4,i-1}.$$

- (3) The method of least squares was applied to these transformed data and the following regression equation was obtained

$$Y_1^* = -40.72 + 140.93X_1^* - 1023.78X_4^*.$$

(21.8718) (-7.4293)

The computed value of the Durbin-Watson statistic is 1.63. The lower and upper bounds for this statistic are 0.74 and 1.25, respectively, at the 1% level of significance. The critical values at the 5% level are 0.98 and 1.54 for the lower and upper bounds, respectively. Thus, the Durbin-Watson test on the residuals indicates that there is no evidence of serial correlation at either the 1% or 5% level of significance.

The statistic for the von Neumann ratio test is 1.74. The lower and upper critical values are 1.01 and 3.25, respectively, at the 1% level of significance. At the 5% level the lower critical value is 1.30 and the upper critical value is 2.96. Therefore, this test would

indicate that there is no evidence of serial correlation in the residuals at either the 1% or 5% level of significance.

The number of runs is 7. Since the critical values are 4 and 13, the residuals behave like a random sequence.

The t-values indicate that the coefficients for X_1^* and X_4^* are significantly different from zero.

The direction of change in beef consumption indicated by the regression coefficients X_1^* and X_4^* is consistent with the previous assumptions regarding the probable effects of these variables.

The constant -40.72 is an estimate of $b_0(1-r)$, so that the relation may be stated in terms of the original variables as follows:

$$Y_1' = -65.80 + 140.93X_1 - 1023.78X_4.$$

The total amount of variation accounted for is 98.64%.

The standard error of estimate is 33.03 million pounds.

The analysis-of-variance table is as follows:

Table 2-4 Analysis-of-Variance Table for
Beef Consumption.

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio
Regression	2	1103434.249	551717.125	505.83**
Error	14	15270.131	1090.723	
Total	16	1118704.380		
**Significant at the 1% level.				

When the regression equation for beef consumption based on the original data is compared with the regression equation based on differences, the standard error of estimate and the variation accounted for are only slightly different. However, when differences are used, all evidence of serial correlation in the residuals is eliminated. Therefore, the latter regression equation has been chosen for the forecasts which will be made in the following chapter.

2.5 The Regression Equation for Pork Consumption

Two linear four-variable regression equations were fitted to the data for pork consumption. Three of the variables remained the same in both equations. Aggregate disposable income was the third independent variable in the first equation while per capita disposable

income was the third independent variable in the second equation. The variables were introduced into the regressions in the stepwise order.

The first regression equation obtained was

$$Y_2' = 976.78 + 10.490X_2 - 811.71X_5 + 26.890X_1$$

$$(0.9921) \quad (-5.7736) \quad (1.1089)$$

where Y_2 = pork consumption in millions of pounds,

X_2 = personal disposable income in billions of (1955) dollars,

X_5 = ratio of the index for pork prices to the index for meat and poultry prices²,

X_1 = population in millions.

The percentage of variation accounted for by each of the three independent variables was as follows:

X_2 accounted for 69.82% of the variation.

X_5 accounted for 21.01% of the variation.

X_1 accounted for 0.79% of the variation.

The total variation accounted for was 91.62%. The standard error of estimate was 33.37 million pounds.

The Durbin-Watson statistic was 1.59. The von Neumann ratio was 1.69. The critical values for these statistics are the same as those for the four-variable

² Another index for meat and poultry prices which might have been used is one excluding pork prices.

regression equation for beef consumption. The Durbin-Watson statistic indicates no evidence of serial correlation at the 1% level of significance but it is inconclusive at the 5% level. The von Neumann ratio indicates that there is no significant serial correlation in the residuals at either the 1% or 5% level of significance. The number of runs was 7. The critical values are 5 and 14.

The second regression equation obtained was

$$Y_2' = 785.98 + 45.747X_1 - 812.42X_5 + 0.0772X_3$$

$$(3.0300) \quad (-5.5917) \quad (0.3285)$$

where Y_2 , X_1 , and X_5 are the same as those in the previous regression equation and X_3 is per capita disposable income.

The variation accounted for by each of the independent variables was:

X_1 accounted for 69.34% of the variation.

X_5 accounted for 21.64% of the variation.

X_3 accounted for 0.07% of the variation.

The total amount of variation accounted for was 91.06%. The standard error of estimate was 34.47 million pounds.

The Durbin-Watson statistic was 1.44. The von Neumann ratio was 1.53. Thus, there is no evidence of

serial correlation in the residuals at the 1% level of significance when the Durbin-Watson statistic is tested. However, the test is inconclusive at the 5% level. The von Neumann ratio test indicates that there is no significant serial correlation at either the 1% or 5% level of significance. The number of runs was 7. The critical values are 5 and 14.

Thus, both regression equations account for a substantial amount of the variation, the standard errors of estimate are not unduly large, the tests on the residuals indicate that there is no significant serial correlation, and the direction of change in pork consumption indicated by the regression coefficients X_1 , X_2 , X_3 , and X_5 is consistent with the previous assumptions regarding the probable effects of these variables. However, the t -values for X_2 and X_1 in the first equation indicate that the coefficients of these variables are not significantly different from zero. The t -value for X_3 in the second equation indicates that its coefficient is not significantly different from zero. Therefore, X_1 will be eliminated from the first equation since it accounts for the least amount of the variation. X_3 will be eliminated from the second equation.

As a result of the above findings two new regression

equations were obtained. After eliminating X_1 as a variable, the regression equation obtained was

$$Y'_2 = 1172.03 + 22.026X_2 - 800.14X_5$$

$$(11.5637) \quad (-5.6608)$$

The amount of the variation accounted for by each of the independent variables was as follows:

X_2 accounted for 69.82%.

X_5 accounted for 21.01%.

The total variation accounted for was 90.82%. The standard error of estimate was 33.64 million pounds.

The Durbin-Watson statistic was 1.63. The von Neumann ratio was 1.73. The critical values for these statistics are the same as those for the three-variable regression equation for beef consumption. Thus, both tests on the residuals indicate that there is no evidence of serial correlation at either the 1% or 5% level of significance. The number of runs was 8. The critical values are 5 and 14.

The direction of change in pork consumption indicated by the regression coefficients X_2 and X_5 is consistent with the previous assumptions.

The t-values indicate that the coefficients of X_2 and X_5 are significantly different from zero.

The analysis-of-variance table is as follows:

Table 2-5 Analysis-of-Variance Table
for Pork Consumption.

Source	Degrees of of Freedom	Sum of Squares	Mean Square	F-Ratio
Regression	2	156793.712	78396.856	69.273**
Error	14	15843.966	1131.712	
Total	16	172637.678		
**Significant at the 1% level.				

Therefore, the above regression equation appears to have good predictive value and will be used for the forecasts in the next chapter.

When X_3 was eliminated as a variable, the regression equation obtained was

$$Y_2' = 804.33 + 50.484X_1 - 814.208X_5.$$

(11.6753 (-5.7956)

The amount of variation accounted for was as follows:

X_1 accounted for 69.34% of the variation.

X_5 accounted for 21.64% of the variation.

The total variation accounted for was 90.98%. The standard error of estimate was 33.35 million pounds.

The Durbin-Watson statistic was 1.39. The von Neumann ratio was 1.47. There is no evidence of serial correlation in the residuals at the 1% level of significance when the Durbin-Watson statistic is tested. However, the test is inconclusive at the 5% level. The von Neumann ratio test indicates that there is no significant serial correlation at either the 1% or 5% level of significance. The number of runs was 7. The critical values are 5 and 14.

The regression coefficients are significantly different from zero and they meet the assumptions regarding their probable effects on pork consumption. However, the Durbin-Watson statistic was inconclusive at the 5% level of significance and it was considered necessary to transform the original data using differences.

The coefficient of correlation for the first-order autoregressive scheme for the residuals was 0.1466. The original variables were transformed as follows:

$$Y_{2i}^* = Y_{2i} - 0.1466Y_{2,i-1},$$

$$X_{1i}^* = X_{1i} - 0.1466X_{1,i-1},$$

$$X_{5i}^* = X_{5i} - 0.1466X_{5,i-1}.$$

The regression equation obtained was

$$Y_2^{*'} = 647.27 + 56.274X_1^* - 871.879X_5^*.$$

(12.5061) (-7.3031)

The computed value of the Durbin-Watson statistic was 2.52. The von Neumann ratio was 2.69. The critical values for these statistics are the same as those for the regression equation for beef consumption when differences are used. Thus, both tests on the residuals indicate that there is no evidence of serial correlation at either the 1% or 5% level of significance. The number of runs is 9. The critical values are 4 and 14.

The t-values indicate that the coefficients for X_1^* and X_5^* are significantly different from zero.

The direction of change in pork consumption indicated by the regression coefficients X_1^* and X_5^* is consistent with the previous assumptions regarding the probable effects of these variables.

The constant 647.27 is an estimate of $b_0(1-r)$, so that the relation may be stated in terms of the original variables as follows:

$$Y_2' = 758.48 + 56.274X_1 - 871.879X_5.$$

The total amount of variation in pork consumption accounted for by this regression equation is 89.43%. The standard error of estimate is 36.11 million pounds.

The analysis-of-variance table is as follows:

Table 2-6 Analysis-of-Variance for
Pork Consumption

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio
Regression	2	154391.771	77195.886	59.232**
Error	14	18245.907	1303.279	
Total	16	172637.678		
**Significant at the 1% level.				

Therefore, this regression equation appears to have good predictive value and will be used for the forecasts in the next chapter as well.

2.6 The Regression Equation for Wheat Consumption

Two linear four-variable regression equations were fitted to the data for wheat consumption. The variables were introduced into the regressions in the stepwise order.

The first regression equation obtained was

$$Y_3' = 21.028 + 2.2402X_1 - 0.8108X_6 - 0.1852X_2$$

$$(1.6954) \quad (-0.3362) \quad (-0.3023)$$

where Y_3 = wheat consumption in millions of bushels,

X_1 = population in millions,

X_6 = ratio of the index for flour prices to the
index for potato prices,

X_2 = personal disposable income in billions of
(1955) dollars.

The amount of variation accounted for by the independent variables was as follows:

X_1 accounted for 89.76%.

X_6 accounted for 0.12%.

X_2 accounted for 0.08%.

The total amount of variation accounted for was 89.96%.

The standard error of estimate was 1.34 million bushels.

The statistics for the residuals were as follows:
the Durbin-Watson statistic was 2.59, the von Neumann
ratio was 2.76, the number of runs was 11.

The second regression equation obtained was

$$Y'_3 = 23.770 + 1.825X_1 - 0.9073X_6 + 0.00035X_3$$

$$(2.5186) \quad (-0.3780) \quad (0.0278)$$

where Y_3 , X_1 , and X_6 were the same as in the previous regression equation and X_3 was per capita disposable income. X_1 and X_6 accounted for the same amount of variation as before. X_3 accounted for no additional variation. The total amount of variation accounted for was 89.88%. The standard error of estimate was 1.34

million bushels.

The Durbin-Watson statistic was 2.58. The von Neumann ratio was 2.75. The number of runs was 11.

The lower and upper bounds for the Durbin-Watson statistic for a sample of sixteen observations and three independent variables are 0.63 and 1.44, respectively, at the 1% level of significance. The critical values at the 5% level of significance are 0.86 and 1.73 for the lower and upper bounds, respectively. Thus, there is no evidence of serial correlation in the residuals at the 1% or 5% level of significance in either of the regression equations.

The critical values for the von Neumann ratio are 1.01 and 3.25 at the 1% level of significance and 1.31 and 2.96 at the 5% level of significance. Since the statistics in both equations fall between the two critical values, no evidence of serial correlation is present at either the 1% or 5% level of significance.

The critical values for the runs test are 4 and 14. Hence, the residuals in both equations appear to behave like a random sequence.

However, in the first equation, the t-values indicate that the coefficients of X_1 , X_6 , and X_2 are not significantly different from zero. In the second equation the t-values indicate that the coefficients of X_6 and X_3 are not significantly different from zero. Therefore,

X_2 , X_3 , and X_6 were eliminated as independent variables.

A third regression equation was computed with X_1 as the only independent variable. The regression equation obtained was

$$Y'_3 = 22.966 + 1.850X_1.$$

(11.0783)

The total amount of variation accounted for was 89.76%. The standard error of estimate was 1.25 million bushels.

The direction of change in wheat consumption indicated by the regression coefficient X_1 is consistent with the assumption made previously regarding the probable effect of this variable. Wheat consumption is an insignificant portion of total consumption. Therefore, neither income nor the price of wheat has much effect on the amount consumed.

The analysis-of-variance table is as follows:

Table 2-7 Analysis-of-Variance Table for Wheat Consumption.

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio
Regression	1	191.971	191.971	122.728**
Error	14	21.899	1.564	
Total	15	213.869		
**Significant at the 1% level.				

The Durbin-Watson statistic was 2.59. The lower and upper bounds are 1.10 and 1.37, respectively, at the 5% level of significance. At the 1% level the critical values are 0.84 and 1.09. Hence, there is no evidence of serial correlation in the residuals at either the 1% or 5% level of significance.

The von Neumann ratio was 2.76. The critical values for this statistic are the same as those given for the first and second equations. Thus, no evidence of serial correlation is present at either the 1% or 5% level of significance.

The number of runs is 9. The critical values are 4 and 14 and it may be concluded that the residuals behave like a random sequence.

The t-value of X_1 indicates that the coefficient of X_1 is significantly different from zero.

Therefore, the foregoing regression equation for wheat consumption appears to have good predictive value and will be used for the forecasts in the next chapter.

CHAPTER III

THE ESTIMATES FOR THE HUMAN CONSUMPTION OF BEEF, PORK, AND WHEAT IN CANADA IN 1980.

3.1 Introduction

The data which were used to develop the forecasting models were chosen starting with 1949 in order to avoid the abnormal variations due to World War II and the early post-war period. Consequently, the first general assumption that must be made is that Canada will not become involved in a major war during the forecast period.

Although there were economic fluctuations during the period 1949-65, the forecasting models cannot be expected to deal with major economic upheavals. Thus, it is necessary to assume that there will not be a major depression such as that of the 1930's, or, conversely, a severe inflationary period, prior to 1980.

Also, the forecasting models were constructed in the context of government economic policies during the 1949-65 period. These models cannot provide accurate forecasts if major changes in government policies alter the pattern of behaviour in the variables which were used. Therefore, it is necessary to assume that there will be no major changes in the economic policies of Canadian governments during the forecast period.

Finally, it should be noted that these general assumptions are applicable to the estimates of the independent variables as well.

3.2 Estimates for The Independent Variables

The population forecast chosen for this study was prepared for the Royal Commission On Canada's Economic Prospects and may be found in Hood and Scott (1957). The main assumptions underlying this forecast are the following:

- (1) The mortality rate (number of deaths per year per thousand individuals of a given age and sex) will decline over the forecast period. It was assumed that the mortality rates would decline at a constant rate of change based on past mortality experience with emphasis placed on the post-depression data. Adjustments were made to recognize the expectation that infant mortality and mortality of young children will be reduced at a faster rate than in the past and that it will catch up with experience in countries now more advanced in these respects.
- (2) The fertility rates (number of live births per thousand women in given age groups) will fall for all age groups by 1980. The rates for

women aged 30 and over are expected to fall throughout the period of the forecast. In the age group 25-29 the birth rate will start to fall about the middle of the forecast period. In the youngest age groups, the rates are expected to rise slightly in the first half of the period and then fall in the latter half of the period. The net result of these expectations in terms of the crude birth rate (number of live births per thousand of population) is that the crude birth rate may vary between 24.2 and 25.6 over the period 1956-80.

- (3) That the net immigration (immigration less emigration and deportations) rate will remain constant over the period of the forecast. However, due to the uncertainty of what the appropriate rate should be, forecasts were made on the assumptions of per annum net immigration of 50,000, 75,000, and 100,000 persons.

When all the foregoing assumptions are taken into account, it is predicted that the population will grow at a rate of between 2% and 2½% compounded annually.

Now that data are available for the first ten years of the forecast period, it is necessary to assess the

reasonableness of the forecast before the population projection for 1980 can be accepted as a good estimate.

The actual average net immigration for the periods 1956-60 and 1961-65 was 112,937 and 50,412 persons annually, respectively. The average annual net immigration for the ten years 1956-65 was 81,674 persons. The above figures are slightly overstated because no data are available regarding emigration to countries other than the United States. Net immigration in any period is affected both by domestic conditions and by conditions abroad. The Suez Crisis and the Hungarian Revolution had a marked impact on Canadian net immigration in 1956 and, particularly, 1957 in spite of a recession during the period. Net immigration levelled off to an annual average of 75,311 in 1958 and 1959. In 1960 the Canadian economy showed downward tendencies again and net immigration declined in 1960 and 1961. There has been a steady increase in net immigration since 1962 (Table A-9 of Appendix A). There is no reason to believe that similar fluctuations in annual net immigration will not occur in the future. Thus, the most appropriate forecast would appear to be that based on the assumption of a net immigration rate of 75,000 persons per annum.

The forecasted and actual crude births per thousand for 1960 were 25.3 and 26.9, respectively. The forecast

and actual deaths per thousand for 1960 were 10.3 and 7.8, respectively. This disparity in the forecast and actual births and deaths is probably largely due to the larger annual net immigration than was forecast. The largest proportion of immigrants is under the age of 40. For example, in 1961 almost 85% of the male and 81% of the female immigrant arrivals were under 40 years of age (Canada Year Book, 1962). Thus, a greater annual net immigration than that forecast would tend to reduce the number of deaths per thousand and increase the number of births per thousand. Consequently, the forecast for 1960 of 17,510 thousand persons was underestimated by 360 thousand persons. Unfortunately, births and deaths for 1965 were not available and comparisons of these with those forecast for 1965 were not possible. However, annual net immigration dropped considerably during the 1961-65 period with the result that the forecast for 1965 of 19,520 thousand persons was underestimated by only 51 thousand persons.

Therefore, the population forecast based on an annual net immigration rate of 75,000 persons appears to be reasonable. The population estimate which will be used to estimate beef, pork, and wheat consumption in 1980 is 26.7 million persons.

The forecast for personal disposable income which will

be used in this study is contained in Slater (1957).

The procedure used to derive this forecast was to take the forecast for the gross national product and deduct the estimated proportions of net government revenue and gross business saving. The residual portion is an estimate of personal disposable income.

The procedure that was followed in order to obtain an estimate of the gross national product was as follows:

- (1) The estimated employed labour force was projected to 1980. It was then divided among the main sectors of the economy.
- (2) The output per man employed in each sector was then forecast.
- (3) The estimated output per man in each sector was multiplied by the estimated number of men employed in the corresponding sector to yield a forecast of output for each sector.
- (4) The sector estimated outputs were summed, adjustments were made for such items as rent, indirect taxes, and net exchange of interest and dividends with foreigners and a forecast of gross national product was obtained.

Full details of the methods, data, and assumptions used to obtain the forecast for gross national product are contained in Hood and Scott (1957).

It was predicted that Canada's gross national product would grow at a compound annual rate of from 3.9% to 4.6% or, an average of 4.3%, from 1956-80. The actual gross national product grew at a rate of 4.4% during the period 1956-65. It was noted in the discussion on the population forecast that the actual net immigration rate for the period 1956-65 was somewhat greater than that forecast. Thus, it is reasonable to expect that the gross national product should also grow at a somewhat greater rate. Since there is no evidence that the annual net immigration rate in the future is likely to stay above the 75,000 persons used as a basis for this forecast, the forecast for the gross national product of 76.2 billions of 1955 dollars in 1980 or, a growth rate of 4.3% compounded annually, is considered to be reasonable and will be used in the estimation of personal disposable income in 1980.

Net government revenue was defined as the gross revenue of federal, provincial, and municipal levels of government consisting of taxes, fees, government investment income, and employee and employer contributions to social insurance and government pension funds less transfer payments and subsidies. Another way in which this concept of net government revenue may be defined is to say that it is equal to government expenditures on goods and services

plus budgetary surpluses or less budgetary deficits.

It was predicted that net government revenue would account for approximately 18% of gross national product annually until 1960. Net government revenue was expected to decline to 17.5% by 1965 and 16.4% by 1980. It was anticipated that the three levels of government collectively would run a small deficit during the period. The actual experience has been a decline in net government revenue from 18.8% in 1956 to 16.6% in 1961 and thereafter a steady increase to 18.9% in 1965. However, Canada's economy suffered a recession in 1956 and 1957. The government's response was to increase expenditures on goods and services while simultaneously reducing net government revenues resulting in a fairly large budgetary deficit in 1958. The deficit in 1959, though somewhat less than that in 1958, was still considerable. In 1960 the trend of economic activity showed downward tendencies again which resulted in larger budgetary deficits in 1960 and 1961 than in 1959. Beginning with 1962 net government revenues have risen steadily as a percentage of gross national product while government expenditures on goods and services have declined. The average annual net government revenue for the period 1956-65 was 17.4% of gross national product. If it is assumed that the three levels of government collectively

will run little or no annual deficits during the period 1966-80, it is not unreasonable to assume that government expenditures on goods and services will continue to decline and net government revenue may fall to 16.4% by 1980. Table A-10 of Appendix A shows net government revenue, government expenditures on goods and services, and budgetary surpluses as a percentage of gross national product for the period 1956-65.

Gross business saving was defined as depreciation and similar business costs plus undistributed corporate profits. The main assumptions underlying the forecasts for these two elements of gross business saving are the following:

- (1) A replacement cycle in capital stock may be expected during the forecast period.
- (2) The rates of corporate income tax would not be higher in the future than they were in 1955. Thus, the growth in corporate income after tax would be the same in the future as the rate of growth in the corporate income before tax. It was further assumed that the historical stability in the ratio of undistributed profits to corporation profits after tax would continue into the future. Since it was expected that the corporate sector would

continue to grow relative to the total economy, it was assumed that undistributed profits would increase slightly as a percentage of gross national product by 1980.

As a result of the first assumption, it was predicted that depreciation allowances as a proportion of gross national product would remain about the same during the period 1956-60 but that they would rise between 1961 and 1965 and reach 12.5% of gross national product in 1965. After 1965 it was predicted that depreciation allowances would gradually fall to 11.9% of gross national product by 1980. Table A-11 of Appendix A shows capital consumption allowances and miscellaneous valuation adjustments as a percentage of gross national product for the period 1956-65. It is evident from this table that depreciation as a percentage of gross national product has been very stable during the first ten years of the forecast period and the average of 12.0% for the period was the same percentage as that for 1955. Thus, the predicted peak of a replacement cycle in 1965 has not occurred. Whether such a cycle will or will not occur later in the forecast period would be difficult to predict without a detailed investigation into factors affecting depreciation allowances. However, it is not inconceivable that depreciation allowances may remain at approximately the

same level throughout the forecast period or, if a replacement cycle does in fact occur, that it may exhaust itself by 1980. Therefore, the prediction that depreciation allowances will account for 11.9% of gross national product in 1980 will be used.

The second assumption led to the prediction that undistributed profits would be approximately 3.1% and 3.0% of gross national product in 1960 and 1965, respectively, thereafter rising to 3.3% in 1980. Table A-11 indicates that undistributed profits as a percentage of gross national product fluctuated from a high of 3.7% in 1956 to a low of 2.0% in 1961. The average for the period was 2.7%. Although actual experience between 1956 and 1965 indicates greater variability in undistributed profits than that assumed in the forecast, the prediction that undistributed profits will be 3.3% of gross national product in 1980 is not unrealistic.

After net government revenue and gross business saving are removed from the gross national product, the residual portion is personal disposable income. Thus, it was predicted that personal disposable income, as a percentage of gross national product, would drop from 67.9% in 1955 to 66.9% in 1965 thereafter rising to 68.4% in 1980. Table A-11 of Appendix A shows the actual behaviour of personal disposable income during the period

1956-65. That the behaviour of personal disposable income during this period should be different from that predicted is obvious in view of the differences in the behaviour of net government revenue and gross business saving which were discussed above. Although the forecast behaviour of the various factors which determine personal disposable income has not been very accurate for the first ten years of the forecast period, the predictions for 1980 are not unreasonable. It would be difficult to improve on these forecasts without a detailed investigation which is beyond the scope of this study. Therefore, the forecast for personal disposable income of 52.1 billions of 1955 dollars will be used to estimate pork consumption in 1980.

The final independent variables for which forecasts are required are the price ratios which were used in the regression equations for beef and pork consumption. On examination of these ratios, it is immediately apparent that the pattern of their behaviour during the period 1949-65 was quite erratic. Therefore, rather than assume these ratios to be at a particular level in 1980 or to use an average ratio, it was considered more appropriate to use a range and thus derive a forecast range. The ratios were rounded to one decimal place. The lower and upper values of these ratios were then

chosen as the range. Thus, the range of the ratio for beef consumption was found to be 1.0 to 1.2 while that for pork consumption was 0.9 to 1.1.

3.3 The Estimates for Beef, Pork, and Wheat Consumption In 1980.

Before the forecasts for population and income discussed in the previous section can be used with the forecasting models developed in Chapter II, it is necessary to ascertain whether the high correlation between population and income may be expected to persist throughout the forecast period. Table A-12 of Appendix A shows the forecasts for 1970, 1975, and 1980 for population, aggregate personal disposable income and per capita personal disposable income. The correlations between population and aggregate and per capita disposable income are .9996 and .9993, respectively. Although actual experience will probably show more variability in these factors than has been forecast and thus somewhat lower correlations, the assumption that high correlations will persist throughout the forecast period appears to be valid.

The regression equation for beef consumption was:

$$Y_1' = -65.80 + 140.93X_1 - 1023.78X_4.$$

The forecasts for the independent variables are as follows:

$$X_1 = 26.7 \text{ million persons,}$$

$$X_4 = 1.0 \text{ to } 1.2.$$

Thus, it is estimated that beef consumption in 1980 will fall between 2,468 and 2,673 million pounds.

There were two forecasting models for pork consumption

$$(1) \quad Y'_2 = 1172.03 + 22.026X_2 - 800.14X_5$$

and

$$(2) \quad Y'_2 = 758.48 + 56.274X_1 - 871.88X_5.$$

The forecast for X_1 is the same as that above. The forecasts for X_2 and X_5 are as follows:

$$X_2 = 52.1 \text{ billions of 1955 dollars,}$$

$$X_5 = 0.9 \text{ to } 1.1.$$

Thus the estimated range for pork consumption in 1980 based on the first model is 1,439 to 1,599 million pounds. The estimated range based on the second model is 1,302 to 1,476 million pounds. Both regression equations accounted for a substantial amount of the variation in pork consumption. Therefore, the choice of one estimate for 1980 would depend on whether the

population estimate or the personal disposable income estimate is considered more reliable.

The forecasting equation for the human consumption of wheat was

$$Y'_3 = 22.966 + 1.850X_1.$$

The estimate for 1980 is 72 million bushels.

It should be noted that the annual human consumption of wheat from 1949-64, inclusive, averaged only 35% of the total annual domestic disappearance of wheat. Other domestic uses of wheat and some implications of the foregoing forecasts to the Alberta farmer will be discussed in the next chapter.

CHAPTER IV

CONCLUSIONS

In order to determine what implications the foregoing forecasts will have for Canadian and Albertan agricultural markets in these products in future, it is necessary to examine the recent trends in these markets and to make certain assumptions regarding the possible future trends. Some of these factors will be discussed in the present chapter.

During the 15-year period, 1951-65, beef consumption in Canada rose very rapidly. It increased from 691 million pounds in 1951 to 1,543 million pounds in 1965 (Table 2-1). Although Canadian beef consumption requirements were met almost exclusively by domestic production, Canada was a net importer of beef for the period (Table A-13 of Appendix A). It is expected that during the period 1966-80 beef consumption in Canada will continue to increase and will reach between 2,468 and 2,673 million pounds in 1980. With such a sizeable increase in domestic beef requirements, it is unlikely that Canada will need to seek export markets for its beef. It is equally unlikely that the Canadian Government would permit the domestic beef industry to be undermined by excessive imports of beef from other countries. Thus,

the forecast for beef requirements in 1980 implies a very favourable domestic market outlook for beef producers in Canada up to 1980.

The increase in pork consumption in Canada from 1951-65 was less persistent and less spectacular than the increase in beef consumption during the same period (Table 2-1). Also, Canada was a net exporter of pork during the period with the exception of 1963 (Table A-13 of Appendix A). However, the export market relative to the domestic market may be considered to have had very little effect on the pork industry in Canada, particularly since 1960. There were two forecasting models developed for pork consumption. The more conservative estimate for pork consumption in 1980 is 1,302 to 1,476 million pounds, or, an increase of 35% to 53% over the amount consumed in 1965. If the domestic market remains the major stimulus to Canadian pork production, and there is no evidence to indicate otherwise, the implications to pork producers is a fairly steady though modest growth in the market for pork in Canada to 1980.

The above conclusions regarding the outlook for beef and pork markets in Canada to 1980 are consistent with those reached in the final report of the Royal Commission On Canada's Economic Prospects (1957). In

this report it was concluded that domestic consumption would provide the stimulus for agricultural expansion in Canada to 1980, and that the domestic market for meat and meat products would be strong throughout the period 1956-80.

The market outlook for Canadian wheat producers cannot be determined solely by the projection of the human consumption of wheat in Canada. Exports and other domestic uses of wheat are of much greater importance than the domestic human consumption of wheat.

Canadian wheat competes directly in world markets with the wheat of numerous other countries. Furthermore, both exporting and importing countries have agricultural programs which are designed to encourage the attainment of domestic goals which impede free competition in world markets. The Royal Commission On Canada's Economic Prospects (1957) predicted that during the period 1955-80 Canada should be able to maintain its traditional share of approximately 30% of the world market and thus its annual exports should be between 255 and 300 million bushels over most of the forecast period. The main assumptions underlying this prediction are as follows:

- (1) Due to the declining per capita consumption,
the expectation of only moderate population

growth, and the promotion of domestic production, exports of wheat to Western Europe are unlikely to increase in the future.

- (2) Although population and per capita consumption of wheat are increasing in South America, the opportunities for expanding wheat production in this area are very great, and it is unlikely that exports of wheat to South America will increase in the future.
- (3) In Asia and Africa it is likely that cereal production will not be able to keep pace with population growth. Thus, the countries of Africa and Asia will exert some upward pressure on the volume of world trade in wheat.
- (4) Eastern Europe and the Soviet Union will require substantial imports of wheat from time to time. However, because import requirements may be arbitrarily curtailed, it was assumed that no significant increase in the volume of world trade in wheat would come from this source.

Actual Canadian wheat exports averaged 378 million bushels for the period 1956-65 (Canada Year Book, 1962-67 Editions). During this period exports to Eastern Europe and the Soviet Union increased sub-

stantially over the previous levels. Also, mainland China became an important export market for Canadian wheat. Due to the emphasis currently being placed on policy measures to expand grain production in the U.S.S.R., it would be imprudent to assume that the U.S.S.R. would continue to depend on wheat imports to the same extent in the future as it has in recent years. Because of the lack of authoritative information concerning the production prospects and consumption requirements for wheat in mainland China, it would also be dangerous to assume that wheat exports to that country will continue at the current high level. Thus, though the prediction that wheat exports will average 255 to 300 million bushels annually to 1980 may be somewhat conservative in view of recent developments, an arbitrary increase in predicted annual exports would be unwise. Therefore, on the assumption that Canada will be able to maintain its traditional share of the world wheat market, the prediction that Canada's wheat exports will average between 255 and 300 million bushels annually for the period 1966-80 will be used.

Other domestic uses of wheat consist of seed requirements, animal feed, industrial uses, handling losses, waste, and dockage. Wheat which is used as animal feed must compete with oats and barley in the

feed market. In recent years wheat has constituted only a small percentage of the total oats, barley and wheat used as animal feed. Furthermore, the percentage of wheat used as animal feed has been declining (Table A-14 of Appendix A). Thus, even though cattle and hog production is expected to increase throughout the forecast period, it is unlikely that the use of wheat for animal feed will increase substantially. Since it is likely that wheat exports may decline somewhat from recent levels, the amount of wheat for seed requirements is not likely to increase either. During the period 1951-64 other domestic uses of wheat varied from a high of 120.9 million bushels in 1951 to a low of 81.0 million bushels in 1962 and averaged 101 million bushels annually (Canada Year Book, 1967 Edition and Handbook of Agricultural Statistics Part I - Field Crops 1908-63). For lack of a better estimate, it will be assumed that other domestic uses of wheat will average about 100 million bushels annually to 1980.

Therefore, total requirements of Canadian wheat for exports, other domestic uses, and human consumption might amount to between 427 million and 472 million bushels annually up to 1980. The Royal Commission On Canada's Economic Prospects (1957) predicted that external and domestic requirements for Canadian wheat

would be between 435 million and 480 million bushels over the long run. The implications of these forecasts to the Canadian wheat producer are that he may look to little or no expansion in wheat requirements during the period 1966-80.

In order to relate the implications of the forecasts for Canadian beef, pork, and wheat requirements to the Alberta farmer, it is necessary to examine the importance of these agricultural products in Alberta.

In recent years the three most important income-producing agricultural products in Alberta have been cattle, hogs, and wheat. Together they have provided approximately 70% of the total cash income received by Alberta farmers. Table A-15 of Appendix A shows cash receipts by Alberta farmers from farming operations, cattle, wheat and hogs, and the percentage of cash receipts from farming operations attributed to cattle, wheat and hogs during the period 1960-66, inclusive. The cash receipts from farming operations include the returns from all sales of agricultural products except those associated with direct inter-farm transfers. The prices which were used to value the agricultural products sold were those paid to farmers at the farm level. The income figures include subsidies, bonuses, and premiums which can be attributed to specific products.

Income which is not actually received by farmers, for example, storage, transportation, processing, and handling charges, is excluded. Unfortunately, cash receipts from the sale of cattle include the sale of calves. Table A-16 of Appendix A shows cash receipts from cattle and calves marketings in Alberta and the percentage of the total cash receipts attributed to each during the period 1960-66, inclusive. The discrepancy between total cattle and calves sales shown in Table A-16 and cattle sales shown in Table A-15 are primarily attributable to the fact that livestock marketings in Alberta are not restricted to Alberta produced livestock and also, they exclude Alberta livestock marketed elsewhere. However, the data in Table A-16 do indicate that cattle accounted for the major proportion of the cash income obtained from the sale of cattle and calves.

Thus, the foregoing forecasts would imply that the cash income to Alberta farmers from cattle and hog production could increase substantially in the future provided that Alberta farmers maintain their recent share of the total Canadian market in these products. Although the outlook for expansion in wheat requirements is not promising, wheat could continue to be a major source of farm cash income in Alberta throughout

the period. Table A-17 of Appendix A shows Alberta's share of the Canadian market for cattle, wheat, and hogs for the period 1960-66.

There are three major ways in which expansion in beef and pork production may occur in Canada. Although each of these ways may be expected to be used, it cannot be assumed that they will be applied uniformly across the country. Firstly, new land may be brought into cultivation. Secondly, the existing agricultural land may be used more intensively. The intensification of land use may be brought about by the improvement of land already occupied but never cultivated, by reducing the amount of land under summerfallow, by irrigating, by the more economical use of capital. Livestock production may also be increased by more intensive grain-fed operations resulting in a more rapid turnover of animals for slaughter. Thirdly, the production of some other agricultural products may decline, freeing land and resources to beef and pork production.

Therefore, the implications of the forecasts discussed above are an expression of the market potential in these products for the Alberta farmer. The question of whether the Alberta farmer will be able to exploit the possibilities remains unanswered.

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APPENDIX A

ADDITIONAL DATA

Table A-1 Consumption of Beef, Pork, Poultry, and Other Meat as a Percentage of Total Meat and Poultry Consumption.

Year	Beef %	Pork %	Poultry %	Other Meat %
1949	36.8	35.7	13.6	13.8
1950	34.4	37.2	14.5	13.9
1951	33.0	39.2	15.1	12.7
1952	34.3	35.3	18.2	12.2
1953	40.8	30.5	16.5	12.2
1954	42.7	27.6	17.3	12.3
1955	42.4	30.1	14.8	12.7
1956	42.6	29.3	15.3	12.8
1957	42.1	25.9	19.4	12.6
1958	41.4	30.0	16.2	12.4
1959	38.2	33.0	17.7	11.1
1960	40.6	30.5	16.1	12.8
1961	40.8	29.2	18.2	11.9
1962	40.8	29.3	18.3	11.6
1963	41.7	28.7	18.4	11.2
1964	42.5	28.2	18.7	10.6
1965	42.9	26.8	19.6	10.7

Source: Handbook of Agricultural Statistics Part VI
Livestock and Animal Products 1871-1965,
 Catalogue No. 21-508, Occasional, Dominion
 Bureau of Statistics.
Canada Year Book, 1952-67 Editions, Dominion
 Bureau of Statistics.

Table A-2 Conversion of Flour Consumption to
Wheat Consumption.

Year	Flour Consumption (Pounds Per Capita) (1)	Population Estimates (Millions) (2)	Flour Consumption (Millions of Pounds) (1) x (2)	Wheat Consumption (Millions of Bushels)*
1949	149.7	13.4	2,006.0	46.1
1950	154.9	13.7	2,122.1	48.8
1951	152.1	14.0	2,129.4	49.0
1952	151.6	14.5	2,198.2	50.6
1953	145.4	14.8	2,151.9	49.5
1954	147.6	15.3	2,258.3	51.9
1955	144.3	15.7	2,265.5	52.1
1956	145.1	16.1	2,336.1	53.7
1957	138.8	16.6	2,304.1	53.0
1958	142.8	17.1	2,441.9	56.2
1959	136.0	17.5	2,380.0	54.7
1960	135.2	17.9	2,420.1	55.7
1961	134.1	18.2	2,440.6	56.1
1962	133.5	18.6	2,483.1	57.1
1963	139.1	18.9	2,629.0	60.5
1964	127.1	19.2	2,440.3	56.1
* 2.3 bushels of wheat per cwt. of flour.				

Source: Canada Year Book, 1952-67 Editions, Dominion
Bureau of Statistics.

Table A-3 Per Capita Consumption of
Wheat and Rye Flour.

Crop-Year (Aug-Jul)	Wheat Flour (Pounds Per Capita)	Rye Flour and Meal (Pounds Per Capita)
1948-49	139.2	0.2
1949-50	149.2	0.3
1950-51	158.3	0.3
1951-52	157.0	0.4
1952-53	153.1	0.5
1953-54	131.8	0.6
1954-55	148.5	0.8
1955-56	147.8	0.9

Source: Handbook of Agricultural Statistics Part IV
Food Consumption in Canada 1926-55, Reference
Paper No. 25, Dominion Bureau of Statistics.

Table A-4 Computation of the Personal
Expenditure Index.

Year	Personal Expenditures On Consumer Goods and Services (Millions of Dollars)		Implicit Personal Expenditure Index	
	(Current)	(1949=100)	(1949=100)	(1955=100)
1949	10,923	10,923	100.0	84.4
1950	12,026	11,642	103.3	87.2
1951	13,460	11,817	113.9	96.1
1952	14,781	12,633	117.0	98.7
1953	15,592	13,338	116.9	98.6
1954	16,175	13,650	118.5	100.0
1955	17,464	14,738	118.5	100.0
1956	18,697	15,516	120.5	101.7
1957	20,072	16,083	124.8	105.3
1958	21,245	16,585	128.1	108.1
1959	22,591	17,392	129.9	109.6
1960	23,540	17,945	131.2	110.7
1961	24,466	18,508	132.2	111.6
1962	25,926	19,364	133.9	113.0
1963	27,487	20,235	135.8	114.6
1964	29,666	21,506	137.9	116.4
1965	32,063	22,800	140.6	118.6

Source: National Accounts Income and Expenditures
1926-56, Dominion Bureau of Statistics.
Canada Year Book, 1962-67 Editions, Dominion
Bureau of Statistics.

Table A-5 Computation of Personal Disposable Income.

Year	Personal Expenditures On Consumer Goods And Services	Personal Savings	Personal Disposable Income	
	(Current)	(Current)	(Current)	(1955=100)
	- Millions of Dollars -			
1949	10,923	926	11,849	14,039
1950	12,026	662	12,688	14,550
1951	13,460	1,334	14,794	15,394
1952	14,781	1,291	16,072	16,284
1953	15,592	1,312	16,904	17,144
1954	16,175	809	16,984	16,984
1955	17,464	865	18,329	18,329
1956	18,697	1,541	20,238	19,900
1957	20,072	1,202	21,274	20,203
1958	21,245	1,635	22,880	21,166
1959	22,591	1,357	23,948	21,850
1960	23,540	1,535	25,075	22,651
1961	24,466	1,545	26,011	23,307
1962	25,926	2,317	28,243	24,994
1963	27,487	2,531	30,018	26,194
1964	29,666	2,059	31,725	27,255
1965	32,063	2,927	34,990	29,503

Source: National Accounts Income and Expenditures 1926-56,
Dominion Bureau of Statistics.

Canada Year Book, 1962-67 Editions, Dominion
Bureau of Statistics.

Appendix A, Table A-4.

Table A-6 Table of Weights Used in the
Computation of the Meat and
Poultry Index.

Year	Beef Consumption	Pork Consumption	Poultry Consumption	Other Meat Consumption
	- Millions of Pounds -			
1949	758.1	734.7	280.4	284.8
1950	696.0	753.4	294.3	282.1
1951	691.0	820.6	316.6	265.6
1952	786.1	809.5	416.1	279.7
1953	965.8	722.6	390.5	288.2
1954	1,072.7	693.9	435.1	309.8
1955	1,085.4	772.2	380.4	324.2
1956	1,148.0	790.5	411.1	343.9
1957	1,196.6	738.2	551.5	358.7
1958	1,161.7	843.0	454.3	348.3
1959	1,146.1	990.7	529.6	332.4
1960	1,250.0	939.9	494.2	394.2
1961	1,271.3	910.3	567.0	369.7
1962	1,287.6	925.4	577.5	367.7
1963	1,395.2	958.8	614.9	373.7
1964	1,512.1	1,001.5	665.3	377.0
1965	1,543.2	964.7	707.0	386.1

Sources: Handbook of Agricultural Statistics Part VI
Livestock and Animal Products 1871-1965,
Catalogue No. 21-508, Occasional, Dominion
Bureau of Statistics.
Canada Year Book, 1952-67 Editions, Dominion
Bureau of Statistics.

Table A-7 Table of Indexes Used in the
Computation of the Meat and
Poultry Index.

Year	Beef Index	Pork Index	Poultry Index	Other Meat Index
		- (1949 = 100) -		
1950	118.5	98.3	96.2	105.6
1951	149.8	111.3	113.3	134.2
1952	135.7	97.1	100.8	123.1
1953	111.3	106.8	108.6	105.7
1954	104.8	111.8	95.3	99.8
1955	106.7	98.5	93.8	95.4
1956	107.6	99.1	91.7	95.9
1957	112.0	117.1	88.1	101.1
1958	128.9	113.4	87.2	112.2
1959	137.4	105.1	79.1	114.4
1960	131.6	103.9	80.9	112.6
1961	130.7	113.3	72.7	113.7
1962	143.3	116.9	74.4	116.8
1963	139.2	117.0	76.3	119.6
1964	134.6	114.4	72.7	118.3
1965	140.2	127.6	74.8	121.3

Sources: The Consumer Price Index for Canada (1949=100), (Revision Based on 1957 Expenditures), Catalogue No. 62-518, Occasional, Dominion Bureau of Statistics.

Prices and Price Indexes, December 1966, Catalogue No. 62-002, Dominion Bureau of Statistics.

Table A-8 Table of Indexes Used in the
Computation of the Flour to
Potato Ratio.

Year	Flour Index	Potato Index
	- (1949 = 100) -	
1950	104.8	95.4
1951	106.9	99.9
1952	105.9	196.9
1953	108.9	111.8
1954	110.2	107.6
1955	106.4	134.5
1956	108.8	142.6
1957	113.3	120.8
1958	114.3	131.2
1959	119.9	140.3
1960	125.5	166.5
1961	128.9	137.2
1962	141.0	135.9
1963	147.4	147.7
1964	156.0	171.1

Source: Canada Year Book, 1957, 1962, 1967
Editions, Dominion Bureau of Statistics.

Table A-9 Table of Annual Net Immigrations
1956-65, Inclusive.

Year	Emigrations To U.S.	Deportations	Immigration	Net Immigration
1956	42,363	604	164,857	121,890
1957	46,354	509	282,164	235,301
1958	45,143	664	124,851	79,044
1959	34,599	751	106,928	71,578
1960	46,668	571	104,111	56,872
1961	47,470	592	71,689	23,627
1962	44,272	630	74,586	29,684
1963	50,509	547	93,151	42,095
1964	51,114	722	112,606	60,770
1965	50,035	841	146,758	95,882

Source: Canada Year Book, 1966 and 1967 Editions,
Dominion Bureau of Statistics.

Table A-10 Net Government Revenue, Government Expenditures on Goods and Services, and Government Budgetary Surplus as a Percentage of Gross National Product.

Year	Net Government Revenue	Government Expenditures On Goods and Services	Budgetary Surplus
1956	18.8	17.6	1.1
1957	18.2	17.9	0.3
1958	15.7	18.8	-3.1
1959	17.0	18.6	-1.6
1960	16.7	18.7	-2.0
1961	16.6	19.3	-2.7
1962	16.9	19.0	-2.1
1963	17.0	18.6	-1.6
1964	18.2	18.3	-0.0
1965	18.9	18.3	0.5

Source: Canada Year Book, 1960-67 Editions, Dominion Bureau of Statistics.

Table A-11 Gross Business Saving and Personal Disposable Income as a Percentage of Gross National Product.

Year	Capital Consumption Allowances	Undistributed Profits	Personal Disposable Income
1956	11.9	3.7	66.2
1957	12.6	2.7	66.7
1958	11.9	2.7	69.6
1959	12.0	2.8	68.6
1960	12.2	2.3	69.1
1961	12.1	2.0	69.4
1962	12.1	2.3	69.6
1963	12.0	2.5	69.1
1964	11.8	2.9	66.9
1965	11.8	2.8	67.3

Source: Canada Year Book, 1960-67 Editions, Dominion Bureau of Statistics.

Table A-12 Forecasts for Population, Aggregate
and Per Capita Personal Disposable
Income.

Year	Population (Millions)	Aggregate Personal Disposable Income (Billions of Dollars)	Per Capita Personal Disposable Income (Dollars)
		- (1955 = 100) -	
1970	21.6	33.8	1,565
1975	24.0	42.0	1,750
1980	26.7	52.1	1,951

Sources: Hood and Scott (1957).
Slater (1957).

Table A-13 Canadian Net Exports of Beef
and Pork.

Year	Net Exports of Beef	Net Exports of Pork
	- Millions of Pounds -	
1951	43.9	10.6
1952	32.2	27.4
1953	- 3.1	77.6
1954	-21.2	74.6
1955	-33.1	79.9
1956	-21.1	67.7
1957	1.3	42.0
1958	5.9	67.7
1959	-36.4	74.7
1960	-23.1	55.4
1961	-18.0	16.5
1962	-29.6	16.6
1963	-38.2	-37.4
1964	- 5.0	5.7
1965	63.6	20.3

Source: Livestock and Animal Products Statistics,
1952-66 Issues, Catalogue No. 23-203,
Annual, Dominion Bureau of Statistics.

Table A-14 Wheat Used as Animal Feed as a
Percentage of Total Wheat, Oats,
and Barley Used as Animal Feed.

Crop Year	Wheat, Oats and Barley Used as Animal Feed (Millions of Bushels)	Wheat Used as Animal Feed (% of Total Wheat, Oats and Barley)
1955-56	540.7	14.4
1956-57	520.0	13.4
1957-58	515.3	13.8
1958-59	535.4	13.8
1959-60	524.8	11.8
1960-61	550.0	11.4
1961-62	434.5	10.1
1962-63	507.9	8.7
1963-64	550.8	9.7
1964-65	541.7	8.6
1965-66	563.2	8.7

Source: Grain Trade of Canada, 1961-62 to 1965-66
Issues, Catalogue No. 22-201, Annual,
Dominion Bureau of Statistics.

Table A-15 Cash Receipts by Alberta Farmers from Farming Operations, Cattle, Wheat, and Hogs, and the Percentage of Cash Receipts from Farming Operations Attributed to Cattle, Wheat, and Hogs.

Year	Cash Receipts from				Percentage of Cash Receipts from Farming Operations Attributed to		
	Farming Operations	Cattle*	Wheat	Hogs	Cattle*	Wheat	Hogs
		- Thousands of Dollars -					
1960	474,700	143,808	119,811	61,563	30.3	25.2	13.0
1961	531,510	158,866	141,611	70,986	29.9	26.6	13.4
1962	552,624	173,256	149,521	72,726	31.4	27.1	13.2
1963	523,313	146,998	143,782	59,491	28.1	27.5	11.4
1964	597,792	151,458	205,562	63,950	25.3	34.4	10.7
1965	653,364	182,566	200,415	77,356	27.9	30.7	11.8
1966	754,749	228,342	234,511	79,571	30.3	31.1	10.5
*Includes Calves.							

Source: Farm Cash Receipts, (Fourth Quarter and Annual Totals), 1961, 1963, 1964, 1966, Catalogue No. 21-001, Quarterly, Dominion Bureau of Statistics.

Table A-16 Cash Receipts from Cattle and Calves Marketing in Alberta and the Percentage of the Total Cash Receipts Attributed to Each.

Year	Cash Receipts From			Percentage of the Total Cash Receipts Attributed to	
	Cattle	Calves	Total	Cattle	Calves
	- Thousands of Dollars -				
1960	133,043	9,766	142,809	93.2	6.8
1961	143,007	13,457	156,464	91.4	8.6
1962	153,073	16,497	169,570	90.3	9.7
1963	147,380	10,786	158,166	93.2	6.8
1964	155,204	10,475	165,679	93.7	6.3
1965	183,079	12,716	195,795	93.5	6.5
1966	220,709	16,392	237,101	93.1	6.9

Source: Summary of General Statistics, 1962-67 February Issues, Alberta Bureau of Statistics.

Table A-17 Alberta's Cash Receipts as a Percentage of Canadian Cash Receipts for Cattle, Wheat, and Hogs.

Year	Cattle* %	Wheat %	Hogs %
1960	25.5	23.3	22.2
1961	25.3	23.2	22.3
1962	25.5	22.2	22.0
1963	23.3	19.9	19.4
1964	23.6	21.9	19.9
1965	23.6	21.5	20.4
1966	25.8	23.4	18.8
*Includes Calves.			

Source: Farm Cash Receipts, (Fourth Quarter and Annual Totals), 1961, 1963, 1964, 1966, Catalogue No. 21-001, Quarterly, Dominion Bureau of Statistics.

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